

## CHAPTER 4

# ORAL ANATOMY

This chapter covers the oral anatomy and physiology of the teeth, the histology of their tissues and supporting structures, and concentrates on the external features of the teeth. To understand the material in this section, you must become familiar with the terms used to describe the external features of the teeth. In addition, you must know the numbering system by which the teeth are identified on the standard dental chart used by the armed services. As a basic dental assistant, you must be aware that teeth differ in size, shape, and other characteristics from one person to another. Such knowledge will be useful to you when you fill in dental charts, expose radiographs, clean teeth, and assist in all phases of dentistry throughout your career.

### FORMATION PERIOD

As all living things are forming, they go through a developmental process to reach maturity or a final outcome. When teeth are in the odontogenesis phase (tooth formation), every tooth goes through three developmental processes. They are categorized into the growth, calcification, and eruption periods (illustrated in figure 4-1). The term *emergence* is used to describe the tooth as it is breaking through the gingival tissue.

### GROWTH PERIOD

Dental development usually begins in the fifth or sixth week of prenatal life. By the seventh week, skin cells of the mouth called epithelium thicken along the ridge of the developing jaws creating a horse-shoe shaped band called the dental lamina. The growth period of development is divided into the bud, cap, and bell stages.

#### Bud Stage

From the dental lamina, patches of epithelial cells grow into the underlying tissues. These patches of cells are called tooth buds. As soon as the dental lamina is formed, the tooth buds for the primary teeth develop. Usually 10 tooth buds are present in each dental arch and they give rise to future primary teeth. Tooth buds

for the permanent teeth form between the 17th week of fetal life through the age of 5 years. When the primary teeth are lost, permanent teeth will replace them.

#### Cap Stage

This stage is also known as proliferation (reproduction or multiplication) in which the cells of the tooth grow and the tooth bud takes a hollowed caplike shape. The epithelium of the cap will give rise to the enamel. The zone under the cap is called the dental papilla. The dental papilla gives rise to the dentin, cementum, and the pulp.

#### Bell Stage

The last period of growth is also known as histodifferentiation (the acquisition of tissue characteristics by cell groups) or bell stage. It is here the ameloblast cells form the enamel, odontoblast cells form the dentin, and the cementoblast cells form the cementum.

### MORPHODIFFERENTIATION

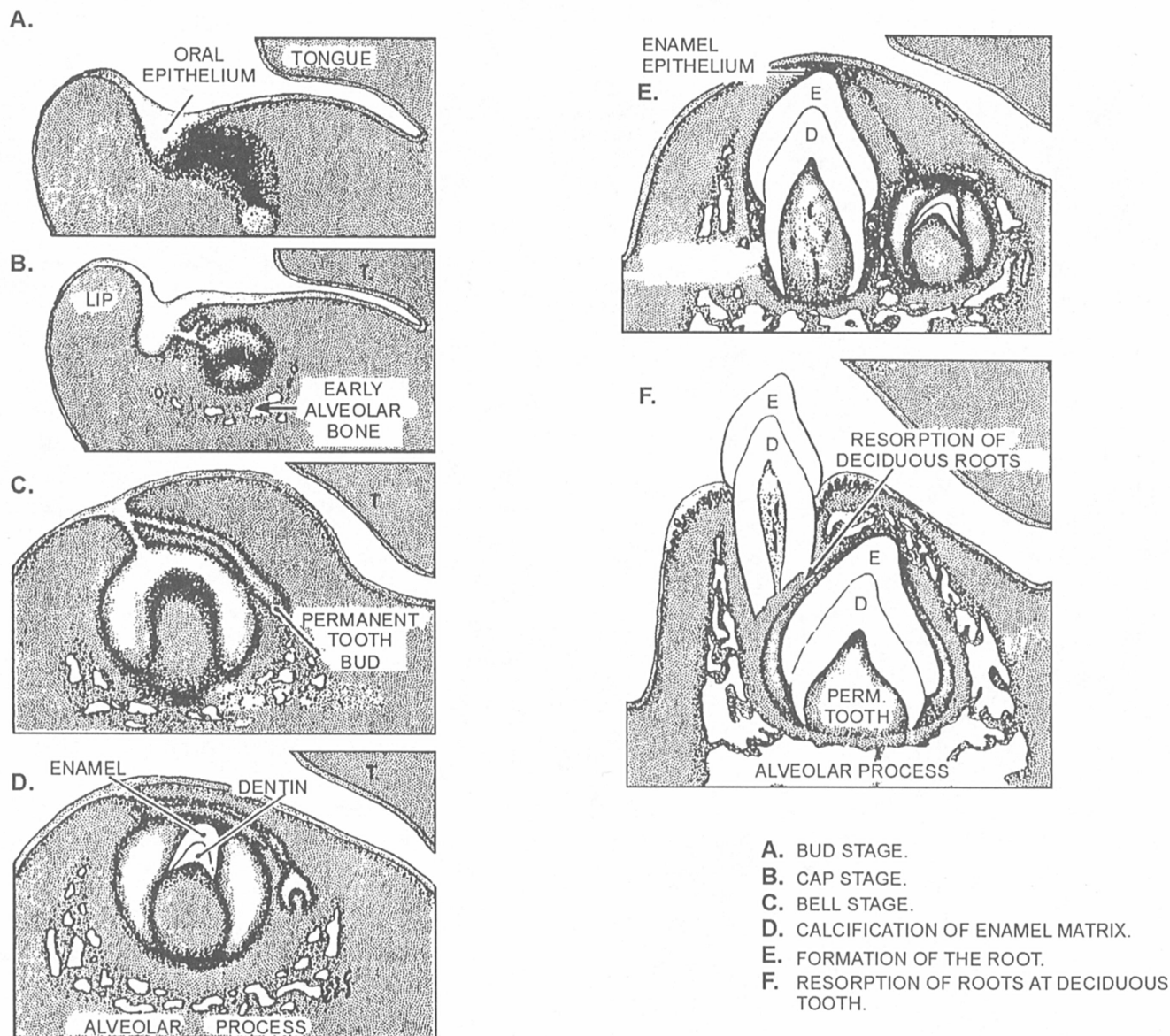
As the tooth is in the bell stage, it begins to take shape and form through a process called morphodifferentiation. Enamel forming cells (ameloblast) and dentin forming cells (odontoblast) line up on a boundary line called dentinoenamel junction.

### APPOSITION

Apposition refers to the depositing of the matrix for the hard dental structures. This matrix is deposited by cells along the boundary line at the end of morphodifferentiation.

### CALCIFICATION

Calcification (fig. 4-1) is the process by which organic tissue (the matrix formed during apposition) becomes hardened by a deposit of calcium or any mineral salts. Next, the tooth crown receives layers of enamel that start at the top of the crown and go downward over the sides to the cementoenamel junction.



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**Figure 4-1.—Stages in development of a tooth.**

## ERUPTION

After the crown of the tooth has formed, the root begins to develop. Now the tooth begins to erupt (fig. 4-1), which is a movement of the tooth into its proper position in the mouth. For permanent teeth, it takes about 3 years from crown completion to the time the tooth emerges into the mouth. Figures 4-2 and 4-3 list the average emergence periods of primary and permanent teeth.

## EXFOLIATION

When primary teeth get ready to fall out and make way for the eruption of permanent teeth, they go through a process called exfoliation (shedding). The

root of the primary tooth resorbs (looses structure) as the permanent tooth erupts from beneath. The primary teeth act as guides for the developing permanent teeth. The premature loss of primary teeth can have a serious impact on the eruption of permanent teeth and how they will be in position in the dental arch.

## ORAL HISTOLOGY

Histology is the study of anatomy that deals with the minute structure, composition, and functions of tissues. Oral histology describes in detail the tissues of the teeth, periodontium, and the surrounding oral mucosa.

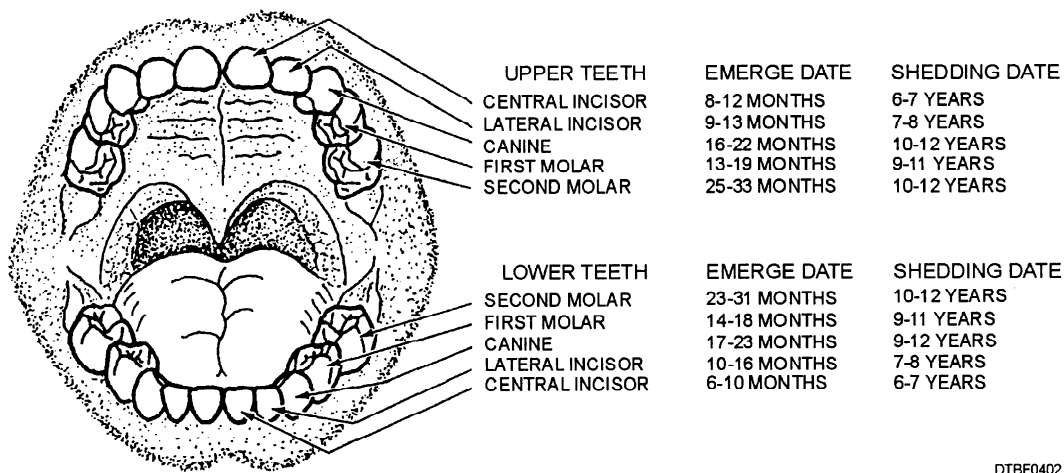


Figure 4-2.—Average periods for emergence and exfoliation of primary teeth.

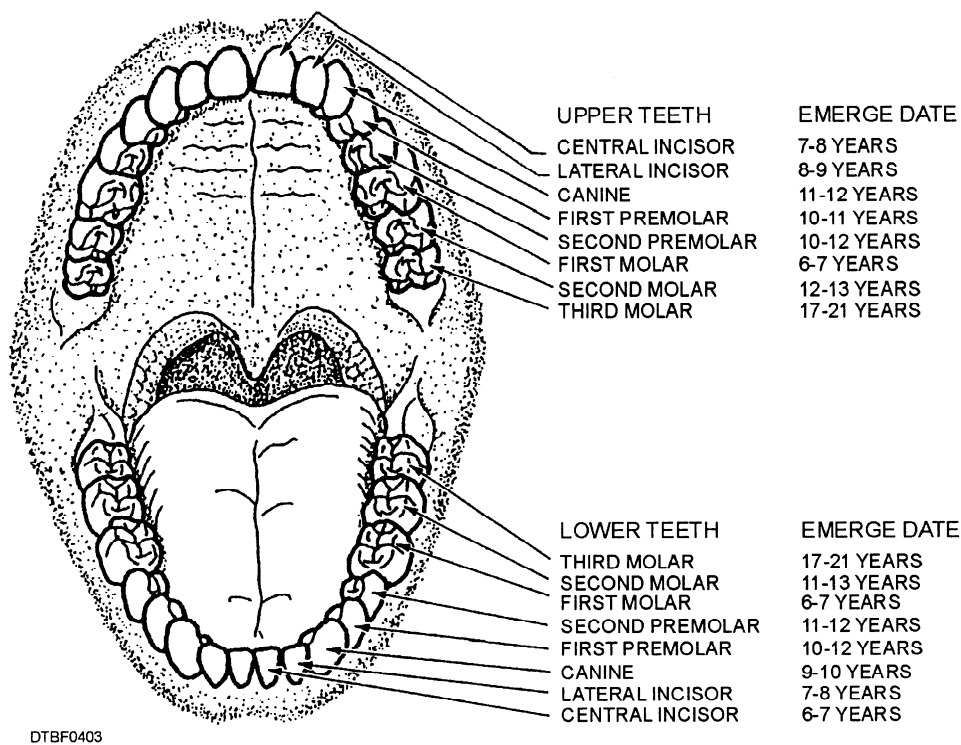


Figure 4-3.—Average periods of emergence of permanent teeth.

## STRUCTURE OF TEETH

A tooth is divided into two parts: the crown and one or more roots. Figure 4-4 illustrates the tooth crown and root.

### The Crown

The crown is divided into the anatomic and clinical crown. The anatomical crown is that portion of the tooth encased in enamel. In young people, areas of the

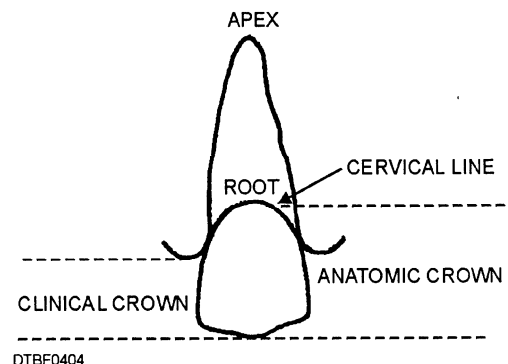


Figure 4-4.—Tooth crown and root.

anatomical crown are frequently buried in gingival tissue. As a person gets older, it becomes common for a tooth's enamel to be completely exposed above the gingiva and to have root surface showing (gingival recession). The term *clinical crown* is applied to the part of the crown exposed (visible) in the mouth.

## The Root

The root of a tooth is embedded in alveolar bone and is covered by cementum. The tooth may have a single root or it may have two or three roots. When teeth have more than one root, the region where the roots separate is called the *furcation*. When a tooth has two roots, the root portion is said to be bifurcated. When it has three roots, the root portion is said to be trifurcated (fig. 4-5). If a tooth has four or more roots, it is said to be multirooted. The tip of each root is called apex. On the apex of each root, there is a small opening that allows for the passage of blood vessels and nerves into the tooth. This opening is called the apical foramen.

## The Cervix

The *cervix* or cervical line (fig. 4-4) is a slight indentation that encircles the tooth and marks the junction of the crown with the root. The cementum joins the enamel at the cervix of the tooth. The point at which they join is called the cemento enamel junction or cervical line.

## TISSUES OF THE TEETH

This section describes the histologic structures of enamel, dentin, cementum, and the dental pulp. Figure 4-6 illustrates the tissues of the teeth.

### ENAMEL

Enamel is translucent and can vary in color from yellowish to grayish white. The different colors of

enamel may be attributed to the variation in the thickness, translucent properties, and the quality of the crystal structure and surface stains of enamel.

Enamel (fig. 4-6) is the calcified substance that covers the entire anatomic crown of the tooth and protects the dentin. It is the hardest tissue in the human body and consists of approximately 96% inorganic minerals, 1% organic materials, and 3% water. Calcium and phosphorus (as hydroxyapatite) are its main inorganic components. Enamel can endure crushing pressure of approximately 100,000 pounds per square inch. A layering of the dentin and periodontium, coupled with the hardness of the enamel, produces a cushioning effect of the tooth's different structures enabling it to endure the pressures of mastication. Structurally, enamel is composed of millions of enamel rods or prisms. Each rod begins at the dentinoenamel junction (junction between the enamel and dentin) and extends to the outer surface of the crown. Enamel is formed by epithelial cells (ameloblasts) that lose their functional ability when the crown of the tooth has been completed. Therefore, enamel, after formation, has no power of further growth or repair.

### DENTIN

Dentin (fig. 4-6) is the light yellow substance that is more radiolucent than enamel and is very porous; it constitutes the largest portion of the tooth. The pulp chamber is located on the internal surface of the dentin walls. Dentin is harder than bone but softer than enamel. Dentin consists of approximately 70% inorganic matter and 30% organic matter and water. Calcium and phosphorus are its chief inorganic components.

Dentin is a living tissue and must be protected during operative or prosthetic procedures from dehydration (drying) and thermal shock. The dentin is perforated by tubules (similar to tiny straws) that run between the cemento enamel junction and the pulp. Cell processes from the pulp reach part way into the tubules like fingers. These cell processes create new dentin and mineralize it. Dentin transmits pain stimuli by the way of dentinal fibers. Because dentin is a living tissue, it has the ability for constant growth and repair that reacts to physiologic (functional) and pathologic (disease) stimuli.

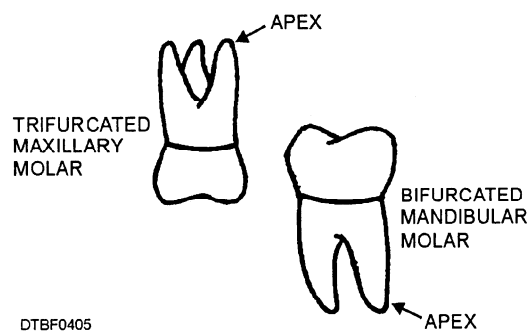


Figure 4-5.—Bifurcated and trifurcated roots.

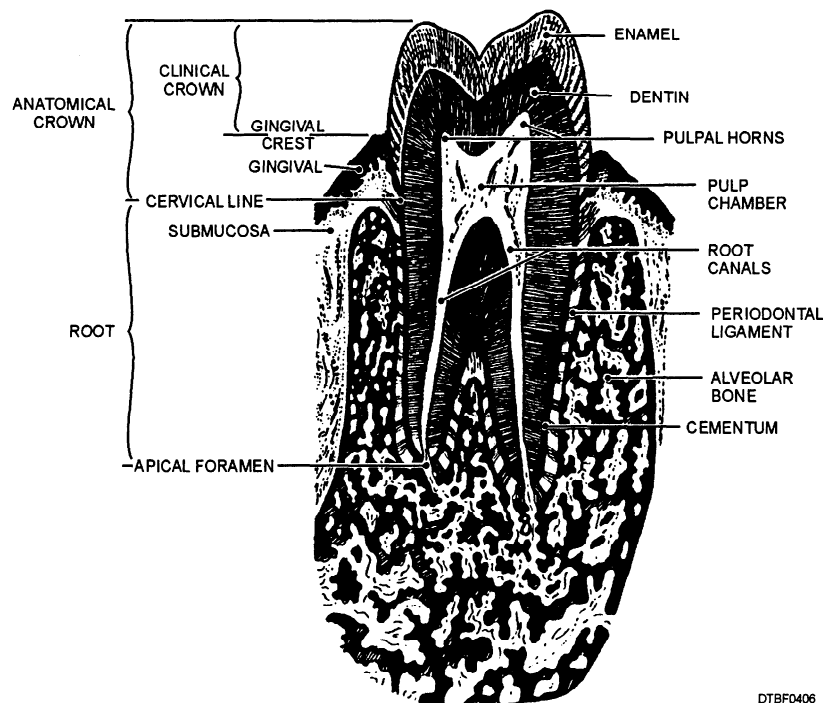


Figure 4-6.—Tissues of the teeth.

## CEMENTUM

Cementum is the bonelike tissue that covers the roots of the teeth in a thin layer (fig. 4-6). It is light yellow in color, slightly lighter than dentin. The cementum is composed of approximately 55% organic material and 45% inorganic material. (The inorganic components are mainly calcium salts.) The cementum joins the enamel at the cervix of the tooth. The point at which they join is called the cementoenamel junction (CEJ). In most teeth the cementum overlaps the enamel for a short distance. In some, the enamel meets the cementum in a sharp line. In a few, a gap may be present between the enamel and the cementum, exposing a narrow area of root dentin. Such areas may be very sensitive to thermal, chemical, or mechanical stimuli.

The main function of cementum is to anchor the teeth to the bony walls of the tooth sockets in the periodontium. This is accomplished by means of the fibers of the periodontal ligament or membrane. Cementum is formed continuously throughout the life of the tooth to compensate for the loss of tooth substance because of occlusal wear, and to allow for the attachment of new fibers of the periodontal ligament to the surface of the root.

## THE DENTAL PULP

The dental pulp, (figure 4-7), is the soft tissue of the tooth, which develops from the connective tissue of the dental papilla. Within the crown, the chamber containing the dental pulp is called the pulp chamber. The pulp contains blood vessels and nerves that enter through the apical foramen. The coronal pulp is within the crown. Within the root is the radicular pulp.

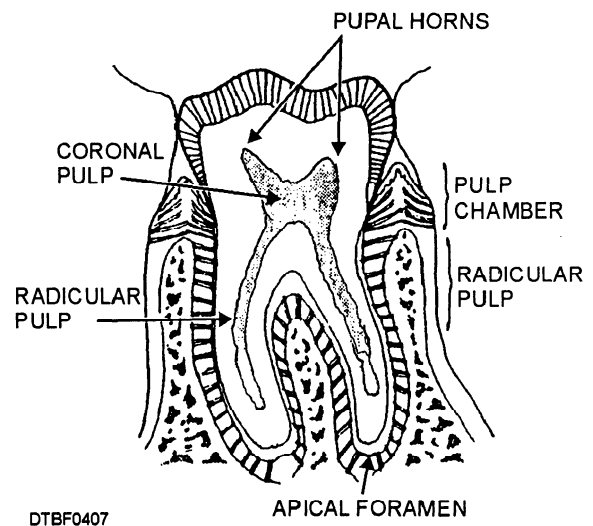


Figure 4-7.—Dental pulp.

The chief function of the pulp is the formation of dentin. However, it also furnishes nourishment to the dentin; provides sensation to the tooth, and responds to irritation, either by forming reparative secondary dentin or by becoming inflamed. The pulp chamber contains the coronal pulp and pulp horns located within the crown portion of the tooth. The apical foramen is at the end or apex of the radicular pulp. Blood vessels, nerves, and connective tissue pass through this area to reach the interior of the tooth.

## PERIODONTIUM

The tissues that surround and support the teeth are collectively called the periodontium. Their main functions are to support, protect, and provide nourishment to the teeth. Figure 4-8 illustrates the supporting tissues of the periodontium. The periodontium consists of cementum, alveolar process of the maxillae and mandible, periodontal ligament, and gingiva.

## CEMENTUM

Cementum is the only tissue considered as both a basic part of the tooth and a component of the periodontium. It is a thin, calcified layer of tissue that completely covers the dentin of the tooth root. Cementum is forming during the development of the root and throughout the life of the tooth. Cementum functions as an area of attachment for the periodontal ligament fibers.

## ALVEOLAR PROCESS

The *alveolar process* (fig. 4-8) is that bony portion of the maxilla and mandible where the teeth are embedded and by which tooth roots are supported.

The alveolar socket is the cavity within the alveolar process in which the root of the tooth is held by the periodontal ligament. The bone that divides one socket from another is called the interdental septum. When multirooted teeth are present, the bone is called the interradicular septum. The alveolar process includes the cortical plate, alveolar crest, trabecular bone, and the alveolar bone proper.

### Cortical Plate

Structurally, the cortical plate is composed of lingual and facial plates of compact bone. It is dense in nature and provides strength and protection and acts as the attachment for skeletal muscles. The mandibular cortical plate is more dense than the maxilla cortical plate and has fewer perforations for the passage of nerves and blood vessels.

### Alveolar Crest

The alveolar crest is the highest point of the alveolar ridge and joins the facial and lingual cortical plates.

### Trabecular Bone

Trabecular or spongy bone lies within the central portion of the alveolar process, and is the less dense,

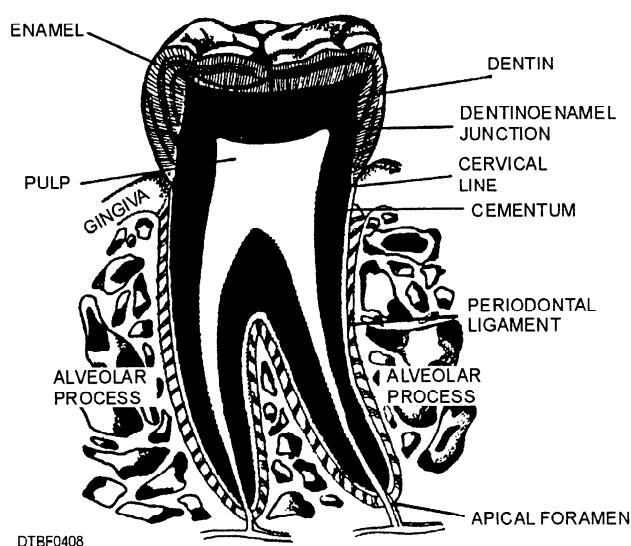


Figure 4-8.—The periodontium.

cancellous bone. When viewed by a radiograph, trabecular bone has a web-like appearance.

### Alveolar Bone Proper

The alveolar bone proper is a thin layer of compact bone, that is a specialized continuation of the cortical plate and forms the tooth socket. The **lamina dura** (fig. 4-10) is a horseshoe shape white line on a dental radiograph that roughly corresponds to the alveolar bone proper.

### PERIODONTAL LIGAMENT

The periodontal ligament (fig. 4-8) is a thin, fibrous ligament that connects the tooth to the bony socket. Normally, teeth do not contact the bone directly; a tooth is suspended in its socket by the fibers of the ligament. This arrangement allows each tooth limited individual movement. The fibers act as shock absorbers to cushion the force of the chewing impact of mastication.

### TISSUES OF THE ORAL CAVITY

The oral cavity is made up of specialized epithelial tissues that surround the teeth and serve as a lining. These tissues are called the oral mucosa and consist of three types: masticatory mucosa, lining mucosa, and specialized mucosa.

#### Masticatory Mucosa

Masticatory mucosa is comprised of the tissue that covers the hard palate and the gingiva.

Masticatory mucosa is usually light pink in color (can vary with skin color) and is keratinized. Keratinized tissue has a horny, tough, protective outer layer of tissue. Characteristics of masticatory mucosa are:

- no submucosa lies under the masticatory mucosa,
- held in place firmly to bone and does not move,
- has a dense, hard covering, and
- functions to withstand the active process of chewing and swallowing food.

**HARD PALATE.**—The hard palate or roof of the mouth (fig. 4-9) is covered with masticatory mucosa and is firmly adhered to the palatine process (bone). Its

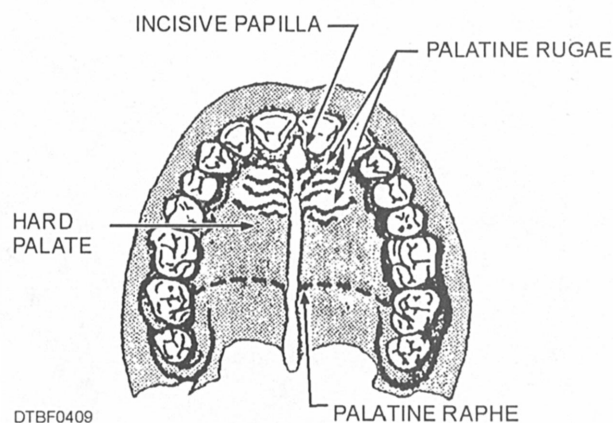


Figure 4-9.—Masticatory mucosa of the hard palate.

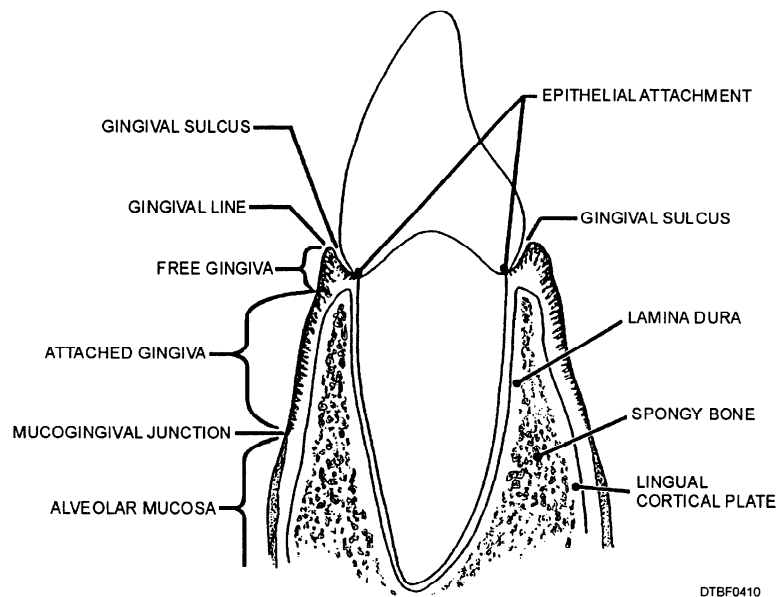
color is usually pale pink. Important structures of the hard palate are:

- Incisive papilla—Located at the midline, directly posterior of the maxillary central incisors (pear-shaped in appearance).
- Palatine raphe—Extends from the incisive papilla posteriorly at the midline (may be ridge shaped in appearance with a whitish streak at the midline).
- Palatine rugae—Extends laterally (along side) from the incisive papilla and from the palatine raphe (wrinkled, irregular ridges in appearance).

**GINGIVA.**—The *gingiva*, shown in figure 4-10, is specialized masticatory mucosa covering the alveolar process. In a healthy mouth, gingiva is firmly in place encircling the necks of the teeth. It aids in the support of the teeth, and protects the alveolar process and periodontal ligament from bacterial invasion. Healthy gingiva is firm and resilient. Healthy gingiva under normal flossing and brushing activities does not bleed. The color of healthy gingiva can range from pale pink to darker shades (purple to black) depending on each individual's pigmentation. The surface of the attached gingiva and interdental papillae may be stippled (resembling the texture of the skin of an orange).

Like the tongue, the gingiva is highly vascular and receives its blood supply from the lingual, mental, buccal, and palatine arteries. Other important aspects of the gingiva are discussed in the following paragraphs.

**Unattached Gingiva.**—The portion of gingiva that extends from the gingival crest to the crest of the bone is called unattached gingiva. It can also be called the free gingiva. It can be displaced and is not bound directly to the tooth or bone. In a healthy mouth, this



**Figure 4-10.—Structures of the gingiva.**

portion is approximately 1 to 3 mm wide and forms the soft tissue wall of the gingival sulcus next to the tooth. Other structures of unattached gingiva include:

- **Gingival margin**—The 1 mm narrow band of gingiva that forms the immediate collar around the base of the tooth. This area is first to show symptoms of gingivitis.
- **Gingival sulcus**—Area between the unattached gingiva and the tooth. Popcorn hulls get trapped in this area.
- **Epithelial attachment**—Joins the gingiva to the tooth surface.
- **Interdental papilla**—The portion of the free gingiva that fills the interproximal embrasures below the contact areas of adjacent teeth. It helps prevent food from packing between the teeth.

**Attached Gingiva.**—Located apical to the free gingiva on the labial and lingual aspects. It is firmly fixed to the underlying bone of the cortical plates of the alveolar process.

**Mucogingival Junction.**—A line that separates the attached gingiva from the lining mucosa.

### **Lining Mucosa**

Lining mucosa is found on the inside of the lips, cheeks, vestibule, soft palate, and under the tongue. It consists of a thin, fragile tissue that is very vascular. Lining mucosa is brighter red in color than masticatory

mucosa. Also included in the lining mucosa is alveolar mucosa. It lies apical to the mucogingival junction and is loosely attached.

## **TOOTH MORPHOLOGY**

This section describes the external features of the teeth. A *tooth* is defined as “one of the hard, bony appendages that are borne on the jaws...and serve for the seizing and mastication of food, as weapons of offense and defense, etc.” In man and the lower animals, the design of the teeth are a reflection of eating habits. Animals, classified according to their eating habits, are carnivorous (flesh eating), herbivorous (plant eating), or omnivorous (eating everything; both flesh and plant).

### **TYPES OF TEETH**

Man is omnivorous, so his teeth are formed for cutting, tearing, and grinding food. The human permanent dentition is divided into four classes of teeth based on appearance and function or position. Figure 4-11 illustrates the types and working surfaces of the four classes of teeth.

#### **Incisors**

Incisors are named because they are used to incise food. They are located in the front of the mouth and have sharp, thin edges for cutting. The lingual surface can have a shovel-shaped appearance.

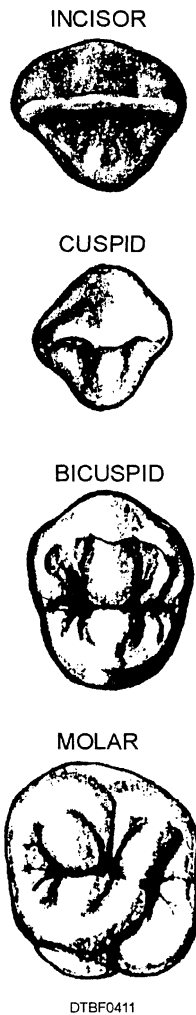


Figure 4-11.—Working surfaces of human teeth.

### Cuspids

cuspids, also referred to as *canines*, are at the angles of the mouth. Each has a single cusp in stead of an incisal edge and are designed for cutting and tearing.

### Bicuspids

Bicuspids, also referred to as *premolars*, are similar to the cuspids. They have two cusps used for cutting and tearing, and an occlusal surface that is wider to crush food.

### Molars

*Molars* are located in the back of the mouth; their size gradually gets smaller from the first to third molar.

Each molar has four or five cusps, is shorter and more blunt in shape than other teeth and provides a broad surface for grinding and chewing solid masses of food.

## DENTAL ARCHES

The teeth of the upper arch are called maxillary teeth, (fig. 4-12) because their roots are embedded within the alveolar process of the maxilla. Those of the lower arch are called mandibular teeth because their roots are embedded within the alveolar process of the mandible. Each arch contains 16 teeth. The teeth in an arch are composed of 6 anteriors (cuspid to cuspid) and 10 posterior (all teeth distal to the cuspids). In a quadrant, there are 3 anterior and 5 posterior teeth.

## DENTAL QUADRANTS

Each dental arch is divided into a right and a left quadrant. The quadrants are formed by an imaginary line called the midline that passes between the central incisors in each arch and divides the arch in half (fig. 4-13). There are four quadrants in the mouth (two

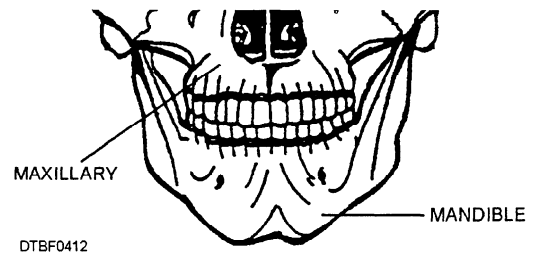


Figure 4-12.—Maxillary and mandibular arches showing relationship of the bones and teeth.

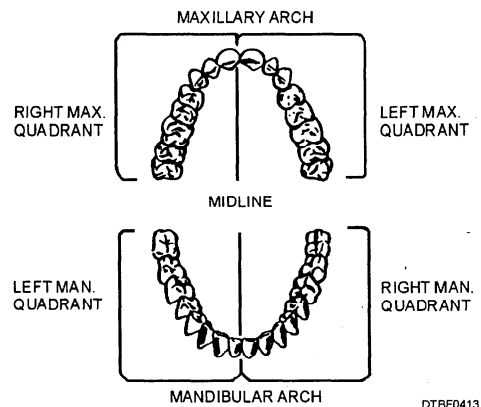


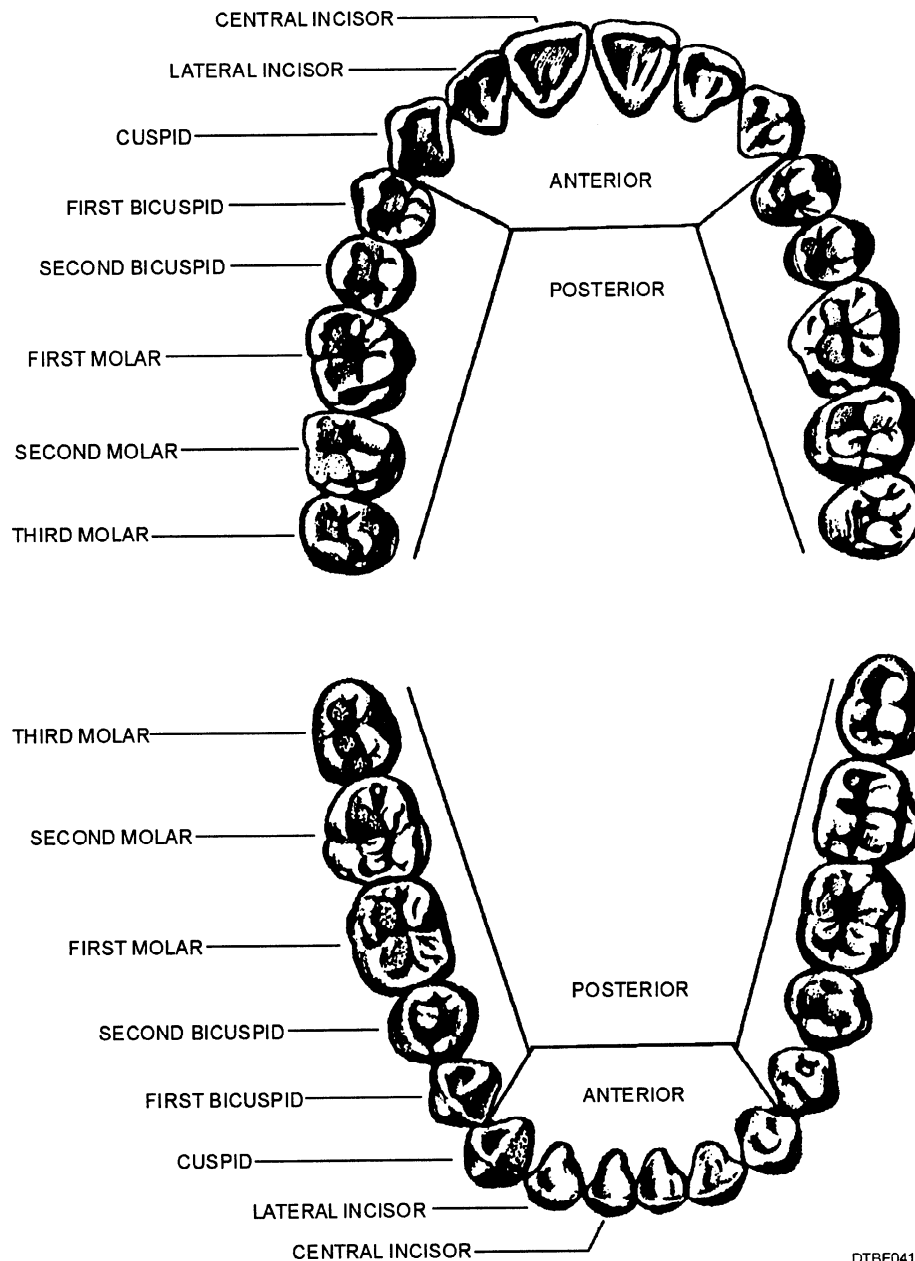
Figure 4-13.—Maxillary and mandibular arches divided into quadrants.

per arch) that divide the mouth into four equal parts. Quadrant means one fourth, and each quadrant is one fourth of the entire mouth. Teeth are described as being located in one of the four quadrants: right maxillary quadrant, left maxillary quadrant, right mandibular quadrant, or the left mandibular quadrant.

## LOCATION OF THE TEETH

Normally, a human receives two sets of teeth during a lifetime. The first (deciduous or primary) set consists of 20 teeth ("baby" teeth). The second

(permanent) set usually consists of 32 teeth. In each quadrant, there are eight permanent teeth: two incisors, one cuspid, two bicuspid, and three molars (fig. 4-14). The tooth positioned immediately to the side of the midline is the central incisor, so called because it occupies a central location in the arch. To the side of the central incisor is the lateral incisor. Next is the cuspid, then the two bicuspids (the first bicuspid, followed by the second bicuspid). The last teeth are three molars. After the second bicuspid comes the first molar, followed by the second molar, followed by the



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Figure 4-14.—Names of the teeth in the right maxillary and mandibular quadrants; anterior and posterior teeth.

third molar or more commonly called the “wisdom tooth.”

Another method of describing the location of teeth is to refer to them as anterior or posterior teeth (fig. 4-15). Anterior teeth are those located in the front of the mouth, the incisors, and the cuspids. Normally, these are the teeth that are visible when a person smiles. The posterior teeth are those located in the back of the mouth—the bicuspid and molars.

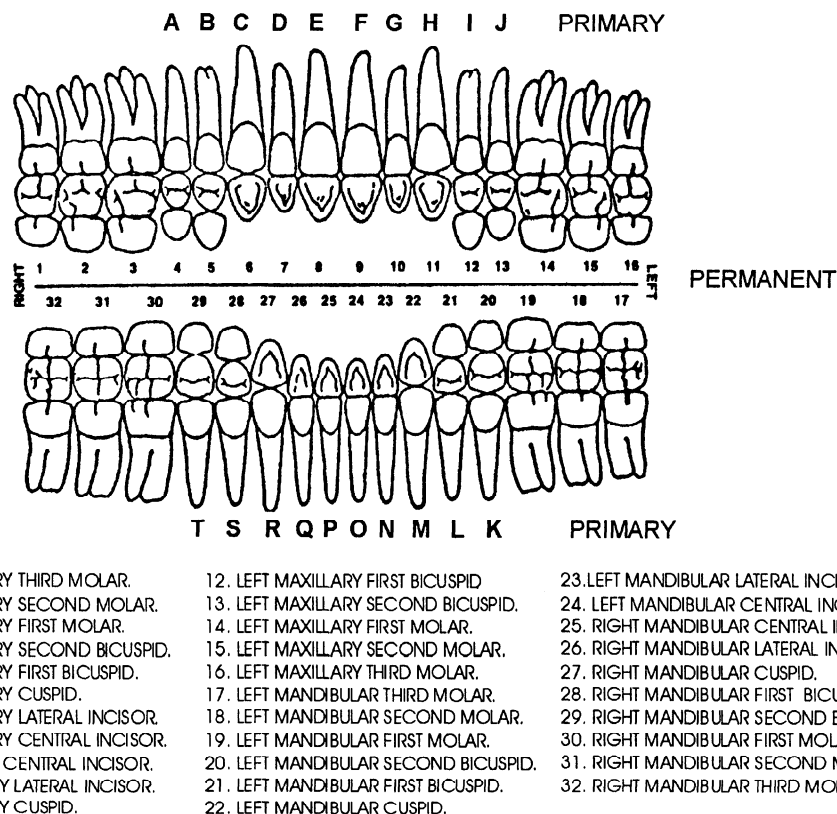
## IDENTIFICATION OF TEETH

To avoid confusion, you must identify a tooth as completely as possible. Give its full name: Central incisor (not incisor), second molar (not molar), etc. But even the full name of a tooth does not provide adequate identification because several teeth have the same name. Complete tooth identification requires that you identify:

- the quadrant in which the tooth appears, and

### PRIMARY

- |  |   |
|--|---|
| A. RIGHT MAXILLARY SECOND PRIMARY MOLAR. | T. RIGHT MANDIBULAR SECOND PRIMARY MOLAR. |
| B. RIGHT MAXILLARY FIRST PRIMARY MOLAR.  | S. RIGHT MANDIBULAR FIRST PRIMARY MOLAR.  |
| C. RIGHT MAXILLARY CUSPID.               | R. RIGHT MANDIBULAR CUSPID.               |
| D. RIGHT MAXILLARY LATERAL.              | Q. RIGHT MANDIBULAR LATERAL.              |
| E. RIGHT MAXILLARY CENTRAL.              | P. RIGHT MANDIBULAR CENTRAL.              |
| F. LEFT MAXILLARY CENTRAL.               | O. LEFT MANDIBULAR CENTRAL.               |
| G. LEFT MAXILLARY LATERAL.               | N. LEFT MANDIBULAR LATERAL.               |
| H. LEFT MAXILLARY CUSPID.                | M. LEFT MANDIBULAR CUSPID.                |
| I. LEFT MAXILLARY FIRST PRIMARY MOLAR.   | L. LEFT MANDIBULAR FIRST PRIMARY MOLAR.   |
| J. LEFT MAXILLARY SECOND PRIMARY MOLAR.  | K. LEFT MANDIBULAR SECOND PRIMARY MOLAR.  |



### PERMANENT

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Figure 4-15.— Standard dental chart; names and numbers of teeth.

- the full name of the tooth.

Therefore, you would identify a specific second molar in the following manner: right mandibular second molar. Although there are four second molars in the mouth, naming the quadrant (right mandibular) narrows the field down to one specific second molar.

## UNIVERSAL NUMBERING SYSTEM

The Universal Numbering System is a simplified method of identifying teeth that is approved by the American Dental Association and used by the armed services. This method employs numbers with each tooth designated by a separate number from 1 to 32. Figure 4-15 illustrates the numbering system used on a Standard Dental Chart. When charting, you would refer to a tooth by number rather than the name. Instead of referring to the right maxillary third molar, you would refer to tooth No. 1. Each permanent tooth has its own number.

The 20 primary teeth are identified on the dental chart by the use of capital letters A to T. Lettering starts with upper right second primary molar (tooth A, located above the root of the maxillary second premolar); goes across to the upper left second primary molar (tooth J); down to the lower left second primary molar (tooth K), and across to the lower right second primary molar. Please note that the letters of the primary second and first molars appear above the roots of the permanent teeth of the second and first premolars.

When using a dental form, remember that the right and left sides are reversed. The right side of the patient's mouth appears on the left side of the dental

chart; the left side of the patient's mouth appears on the right side. This arrangement is necessary because the dental officer and the assistant see the sides reversed when they look into a patient's mouth. Full instructions for using dental forms, will be provided in *Dental Technician*, Volume 2, NAVEDTRA 12573, chapter 2, "Oral Examination."

## SURFACES OF THE TEETH

Not only must the assistant be able to name and locate a tooth, but must also be able to identify the different types of tooth surfaces. Figure 4-16 shows a number of different surfaces of the teeth.

### Facial, Mesial, Distal, Lingual, and Incisal Surfaces

The **facial** is the surface of a tooth that "faces" toward the lips or cheeks. When there is a requirement to be more specific, terms like **labial** and **buccal** are used. The labial is the surface of an anterior tooth that faces toward the lips. The buccal is the surface of a posterior tooth that faces toward the cheek.

The **mesial** is the proximal surface closest to the midline of the arch. The **distal** is the opposite of mesial. The distal is the proximal surface oriented away from the midline of the arch.

The **lingual** is the surface of an anterior or posterior tooth that faces toward the tongue. **Incisal** edges are narrow cutting edges found only in the anterior teeth (incisors). Incisors have one incisal edge.

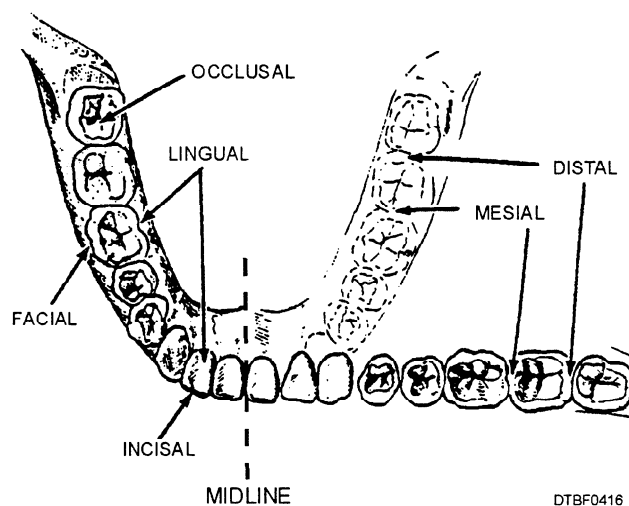


Figure 4-16.—Surfaces of the teeth.

## Proximal Surfaces

A tooth has two proximal surfaces (fig 4-17), one that is oriented toward the midline of the dental arch (mesial) and another that is oriented away from the midline of the arch (distal). Other important surfaces of the proximal area are discussed in the following paragraphs.

**CONTACT POINT.**—The point on the proximal surface where two adjacent teeth actually touch each other is called a contact point. An example of a contact point is when you pass dental floss in between two teeth. You should feel some resistance of the contact point while the floss is being passed through.

**INTERPROXIMAL SPACE.**—The interproximal space is the area between the teeth. Part of the interproximal space is occupied by the interdental papilla. The interdental papilla is a triangular fold of gingival tissue. The part of the interproximal space not occupied is called the embrasure.

**EMBRASURE.**—The embrasure occupies an area bordered by interdental papilla, the proximal surfaces of the two adjacent teeth, and the contact point (fig 4-18). If there is no contact point between the

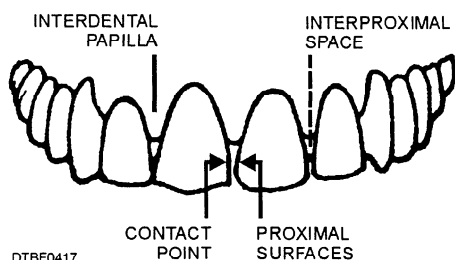


Figure 4-17.—Proximal tooth surfaces and spaces.

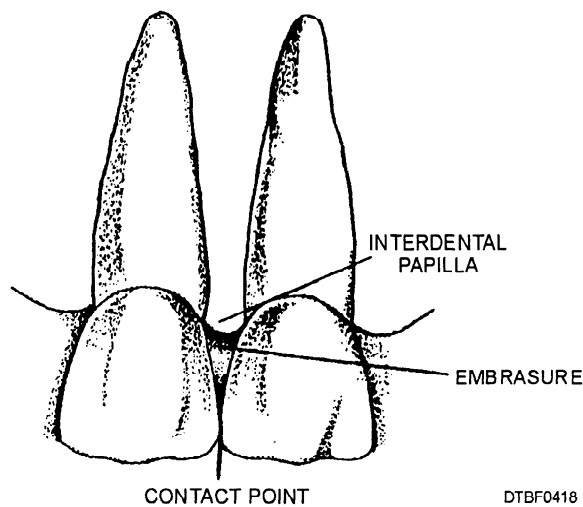


Figure 4-18.—Embrasure.

teeth, then the area between them is called a diastema instead of an embrasure.

## Occlusal

The occlusal surface is the broad chewing surface found on posterior teeth (bicuspid and molars).

To get a clearer picture of the various tooth surfaces, refer to figure 4-15, which has previously been discussed. The Dental Chart shows each of the teeth “unfolded” so that the facial, occlusal, incisal, or lingual surfaces of the teeth can be shown. For posterior teeth, the facial surfaces are shown adjacent to the roots, followed by the occlusal surfaces, and then by the lingual surfaces (which are located next to the numbers on the chart). For the anterior teeth, the facial surfaces are shown as a line between the facial and lingual surfaces. The lingual surfaces are located next to the numbers on the chart.

**OCCCLUSION.**—Occlusion is the relationship between the occlusal surfaces of maxillary and mandibular teeth when they are in contact. Many patterns of tooth contact are possible. Part of the reason for the variety is the mandibular condyle’s substantial range of movement within the temporal mandibular joint. Malocclusion occurs when any abnormality in occlusal relationships exist in the dentition. Centric occlusion, figure 4-19, is the centered contact position of the chewing surfaces of mandibular teeth on the chewing surface (occlusal) of the maxillary teeth.

**OCCLUSAL PLANE.**—Maxillary and mandibular teeth come into centric occlusion and meet along anteroposterior and lateral curves. The anteroposterior curve is called the *Curve of Spee*

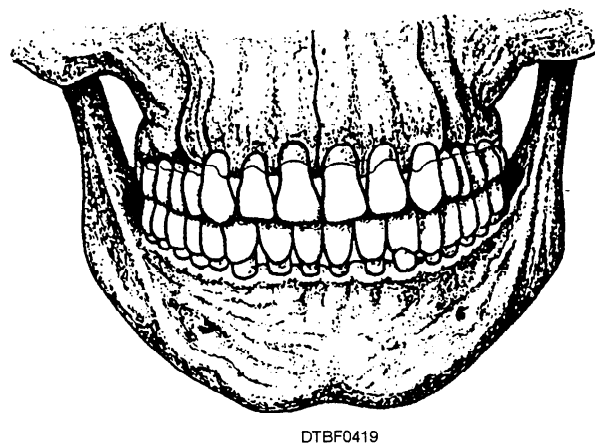


Figure 4-19.—Centric occlusion.

(fig. 4-20) in which the mandibular arch forms a concave (a bowl-like upward curve). The lateral curve is called the *Curve of Wilson* (fig. 4-21). The composite (combination) of these curves form a line called the occlusal plane, and is created by the contact of the upper and lower teeth as shown in figure 4-22.

**VERTICAL AND HORIZONTAL OVERLAP.**—Vertical overlap is the extension of the maxillary teeth over the mandibular counterparts in a vertical direction when the dentition is in centric occlusion (fig. 4-23). Horizontal overlap is the projection of maxillary teeth over antagonists

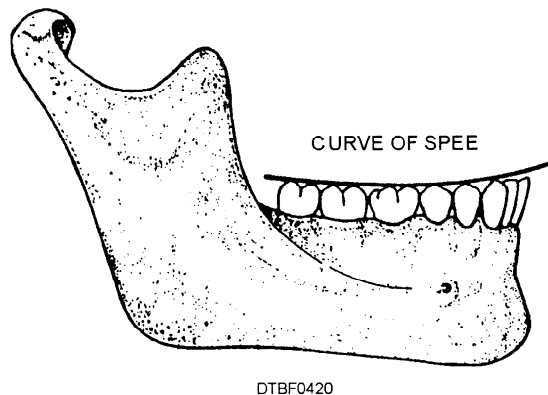


Figure 4-20.—Curve of Spee.

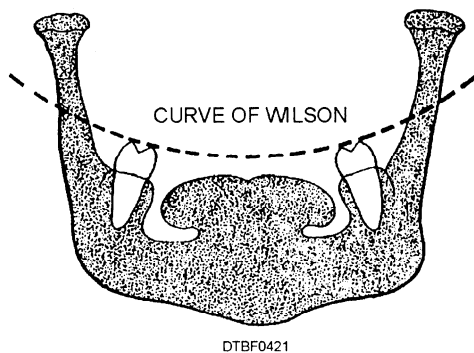


Figure 4-21.—Curve of Wilson.

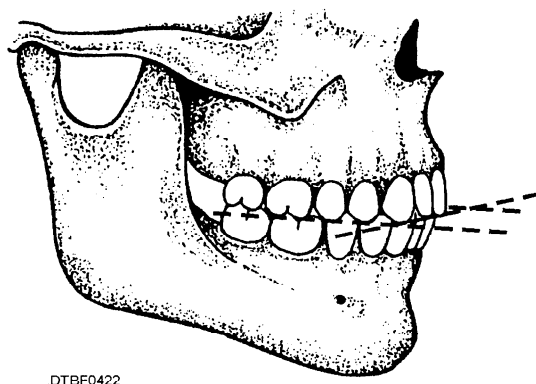


Figure 4-22.—Occlusal plane.

(something that opposes another) in a horizontal direction.

**ANGLES CLASSIFICATION.**—Angle was a dentist who developed a classification of normal and abnormal ways teeth meet into centric occlusion. Angle came up with three classes, Class I, II and III, as illustrated by figure 4-24.

- Class I—patient's profile is characterized as normal.
- Class II—patient's profile is deficient in chin length and characterized as a retruded (retrognathic) profile.
- Class III—patient's profile is excessive in chin length and characterized as protruded (prognathic) profile.

**KEY TO OCCLUSION.**—The occlusal surfaces of opposing teeth bear a definite relationship to each other (fig. 4-25). In normal jaw relations and when teeth are of normal size and in the correct position, the mesiofacial cusp of the maxillary first molar occludes in the facial groove of the mandibular first molar. This normal relationship (fig. 4-26) of these two teeth is called the key to occlusion.

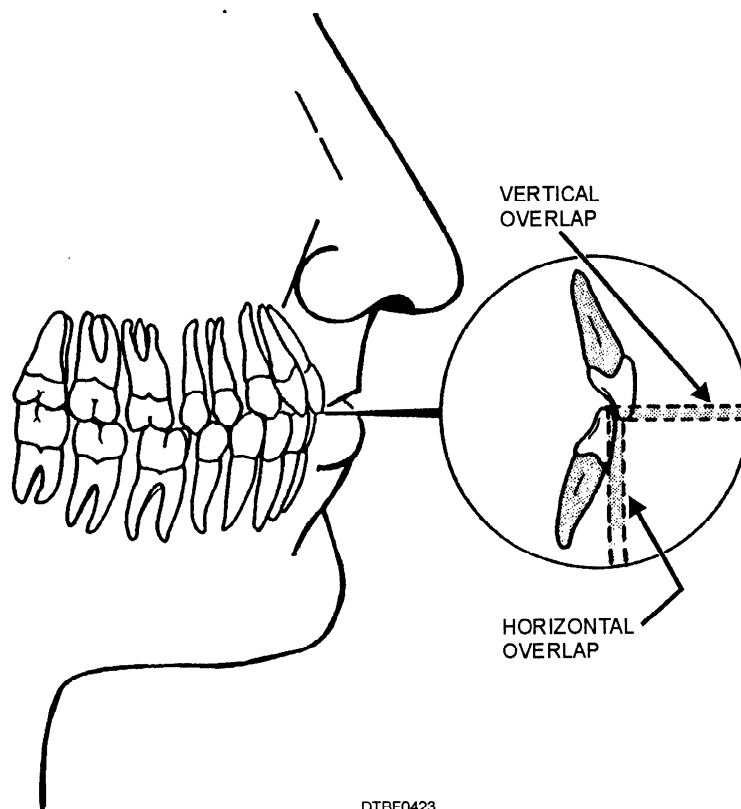
## PERMANENT DENTITION

The permanent dentition consists of 32 teeth. Each tooth in the permanent dentition is described in this section. It should be remembered that teeth show considerable variation in size, shape, and other characteristics from one person to another. Certain teeth show a greater tendency than others to deviate from the normal. The descriptions that follow are of normal teeth.

## MAXILLARY CENTRAL INCISORS

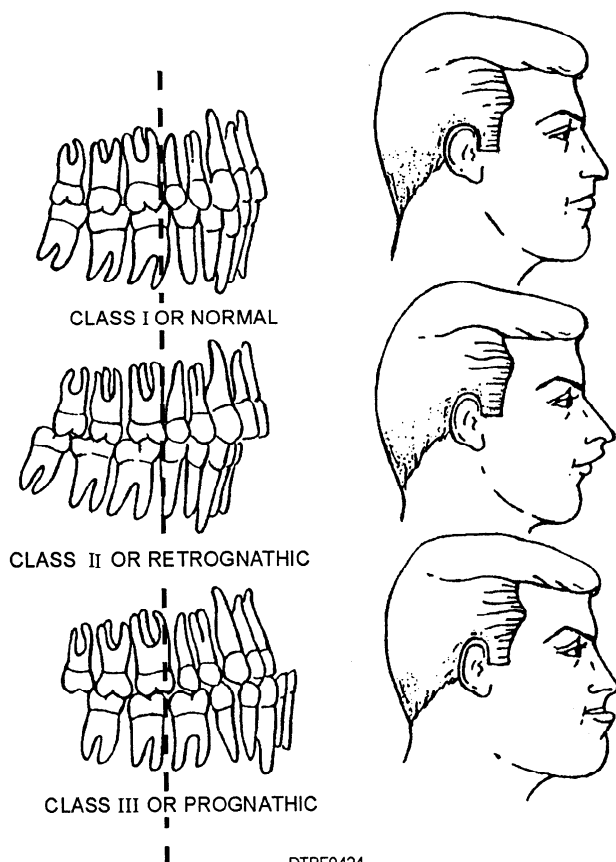
The maxillary central incisor (tooth #8 or #9) is illustrated in figures 4-27 and 4-28. Viewed mesially or distally, a maxillary central incisor looks like a wedge, with the point of the wedge at the incisal (cutting) edge of the tooth.

**Facial Surface**—The facial surface resembles a thumbnail in outline. The mesial margin is nearly straight and meets the incisal edge at almost a 90° angle, but the distal margin meets the incisal edge in a curve. The incisal edge is straight, but the cervical margin is curved like a half moon. Two developmental grooves are on the facial surface.



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Figure 4-23.—Vertical and horizontal overlap.



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Figure 4-24.—Angle's classification.

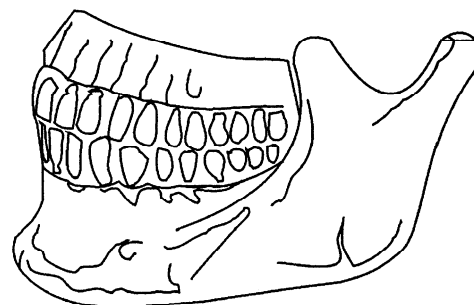
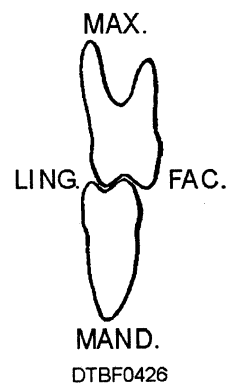
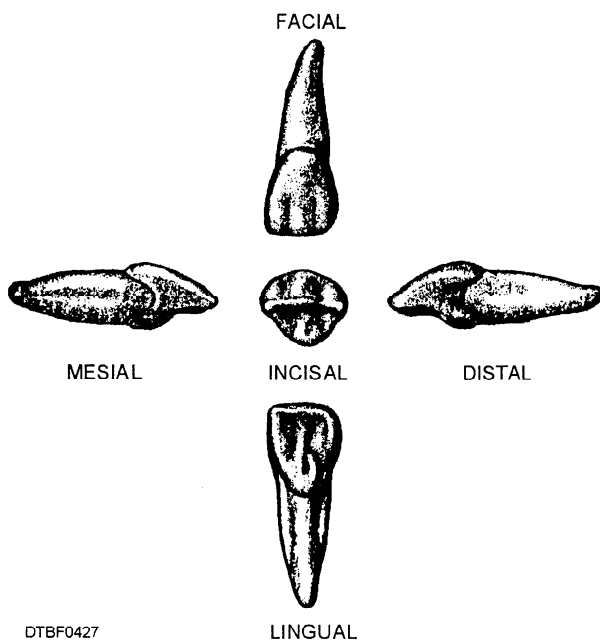


Figure 4-25.—Key to occlusion. Shows relationship of mandible to maxillae.



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Figure 4-26.—Normal cusp relations of posterior teeth.



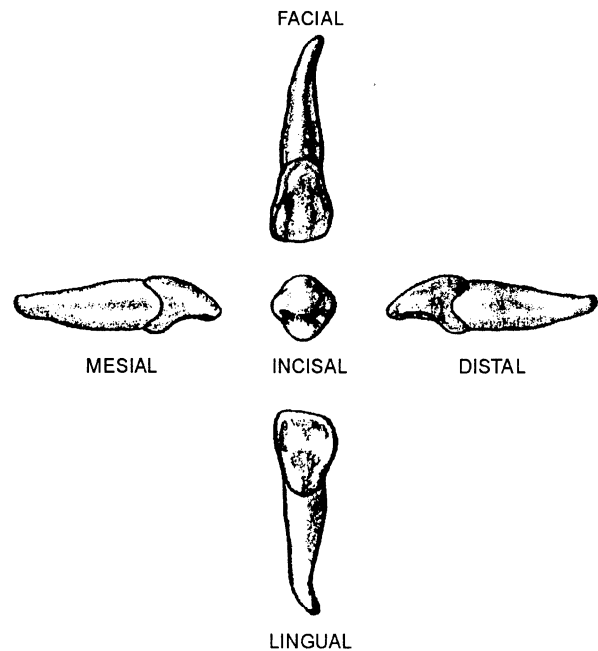
**Figure 4-27.—Surfaces of a maxillary central incisor.**

**Lingual Surface**—The lingual surface (fig. 4-28) is quite similar to the facial surface in outline except that it is slightly smaller in all dimensions. At the mesial and distal margins there are marginal ridges. Occasionally there is a cingulum at the junction of the lingual surface with the cervical line. Sometimes a deep pit, the lingual pit, is found in conjunction with a cingulum.

**Root Surface**—As with all anterior teeth, the root of the maxillary central incisor is single. This root is from one and one-fourth to one and one-half times the length of the crown. Usually, the apex of the root is inclined slightly distally.

### MAXILLARY LATERAL INCISORS

The maxillary lateral incisor (tooth #7 or #10), illustrated in figure 4-29, is much like the maxillary central incisor, except in size: it is shorter, narrower, and thinner.



**Figure 4-29.—Surfaces of a maxillary lateral incisor.**

**Facial Surface**—The developmental grooves on the facial surface are not so evident as those of the central incisor. Of more significance, however, is the distoincisor angle, which is well-rounded with this curvature continuing to the cervical line. The mesiofacial angle is nearly straight to the cervical line.

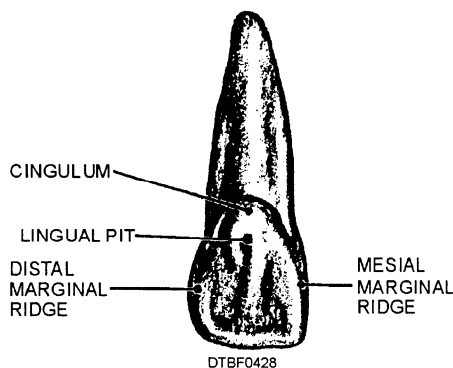
**Lingual Surface**—The shape of the lingual surface varies with the individual. In some persons it is markedly concave, almost spoon-like in appearance, and in others, it is flat. The lingual surface is almost the same as the facial surface.

**Root Surface**—The root is conical (cone-shaped) but somewhat flattened mesiodistally.

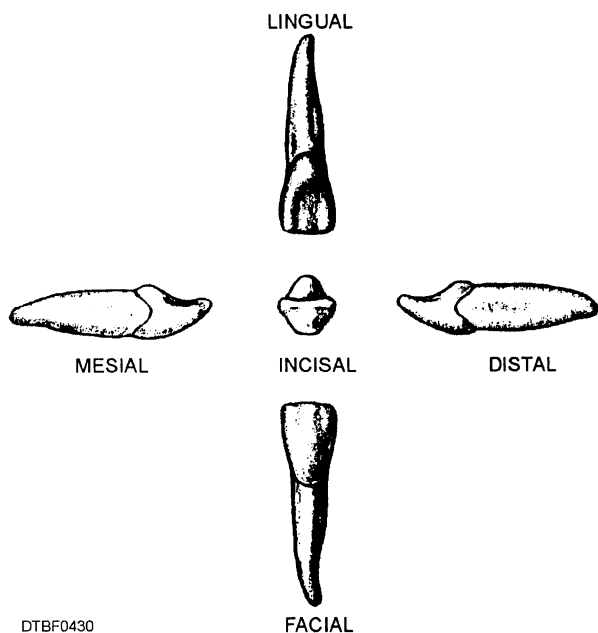
### MANDIBULAR CENTRAL INCISORS

The mandibular central incisor (tooth #24 or #25) is illustrated in figure 4-30. These are the first permanent teeth to erupt, replacing deciduous teeth, and are the smallest teeth in either arch.

**Facial Surfaces**—The facial surface of the mandibular central incisor is widest at the incisal edge. Both the mesial and the distal surfaces join the incisal surface at almost a 90° angle. Although these two surfaces are nearly parallel at the incisal edge, they converge toward the cervical margin. The developmental grooves may or may not be present. When present, they appear as very faint furrows.



**Figure 4-28.—Features of a lingual surface of maxillary central incisor.**



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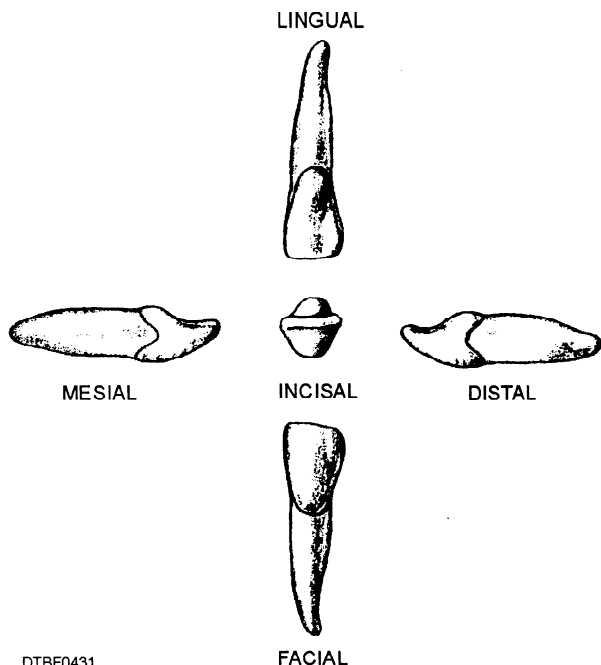
Figure 4-30.—Surfaces of a mandibular central incisor.

**Lingual Surface**—The lingual surface is concave from the incisal edge to the cervical margin.

**Root Surface**—The root is slender and extremely flattened on its mesial and distal surfaces.

## MANDIBULAR LATERAL INCISORS

The mandibular incisor (tooth #23 or #26) illustrated in figure 4-31, is a little wider mesiodistal



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Figure 4-31.—Surfaces of a mandibular lateral incisor.

than the mandibular central incisor, and the crown is slightly longer from the incisal edge to the cervical line.

**Facial Surface**—The facial surface is less symmetrical than the facial surface of the mandibular central incisor. The incisal edge slopes upward toward the mesioincisal angle, which is slightly less than 90°. The distoincisal angle is rounded. The mesial border is more nearly straight than the distal border.

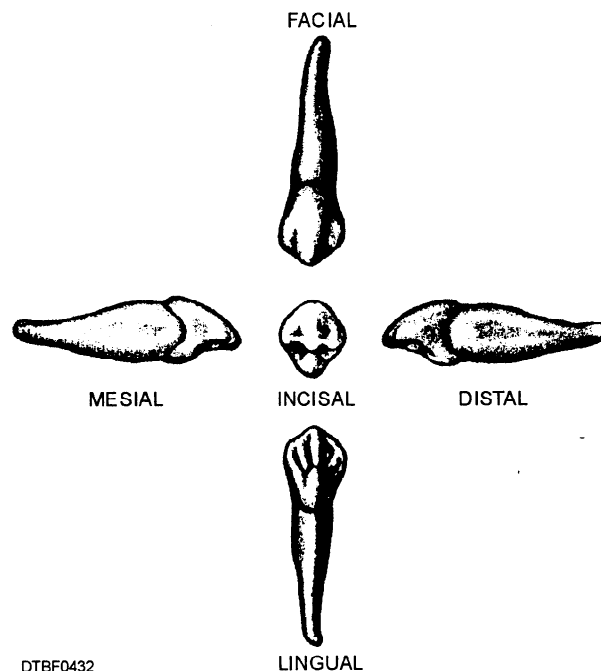
**Lingual Surface**—The lingual surface is similar in outline to the facial surface. The incisal portion of the lingual surface is concave. The cingulum is quite large but blends in smoothly with the rest of the surface.

**Root Surface**—The root is single and extremely flattened on its mesial and distal surfaces.

## MAXILLARY CUSPIDS

The maxillary cuspid (tooth #6 or #11) is illustrated in figures 4-32 and 4-33. The maxillary cuspid is usually the longest tooth in either jaw. Since it resembles a dog's tooth, it is sometimes called the canine.

**Facial Surface**—The facial surface of the crown (fig. 4-33) differs considerably from that of the maxillary central or lateral incisors. In that the incisal edges of the central and lateral incisor are nearly



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Figure 4-32.—Surfaces of a maxillary cuspid.

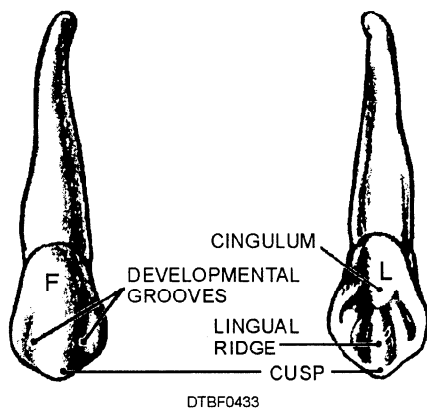


Figure 4-33.—Features of facial and lingual surfaces of a maxillary cuspid.

straight, the cuspid has a definite point, or cusp. There are two cutting edges, the mesioincisal and the distoincisal. The distoincisal cutting edge is the longer of the two. The developmental grooves that are so prominent on the facial surface of the central incisor are present here, extending two-thirds of the distance from the tip of the cusp to the cervical line.

**Lingual Surface**—The lingual surface has the same outline as the facial surface but is somewhat smaller because the mesial and distal surfaces of the crown converge toward the lingual surface. The lingual surface is concave, with very prominent mesial and distal marginal ridges, and a lingual ridge, which extends from the tip of the cusp toward the cervical

line. There is often a cingulum in the cervical portion of the lingual surface of the crown.

**Root Surface**—The root is single and is the longest root in the arch. It is usually twice the length of the crown. This is because the cuspid is designed for seizing and holding food.

## MANDIBULAR CUSPIDS

The mandibular cuspid (tooth #22 or #27) is illustrated in figure 4-34. These teeth, like the mandibular incisors, are smaller and more slender than the opposing teeth in the maxillary arch.

**Facial Surface**—The facial surface of a mandibular cuspid is much the same as that of a maxillary cuspid, except that the distoincisal cutting edge is almost twice the length of the mesial edge.

**Lingual Surface**—The lingual surface as a rule is very smooth, and a cingulum is rarely present.

**Root Surface**—The single root is not so long as that of the maxillary cuspid and is much flatter mesiodistal.

## MAXILLARY FIRST BICUSPID

The maxillary first bicuspid (tooth #5 or #12), illustrated in figures 4-35 and 4-36, is the fourth tooth from the midline. It is considered to be the typical bicuspid. (The word “bicuspid” means “having two

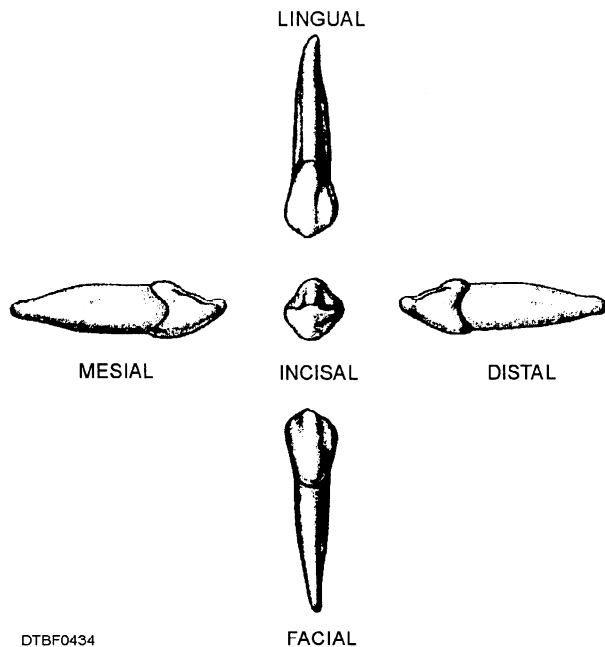


Figure 4-34.—Surfaces of a mandibular cuspid.

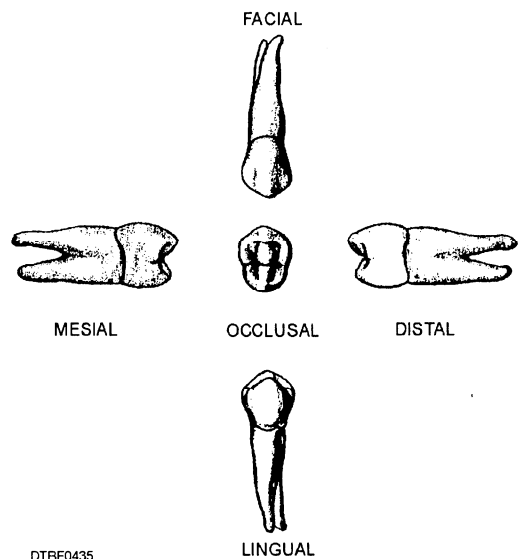


Figure 4-35.—Surfaces of maxillary first bicuspid.

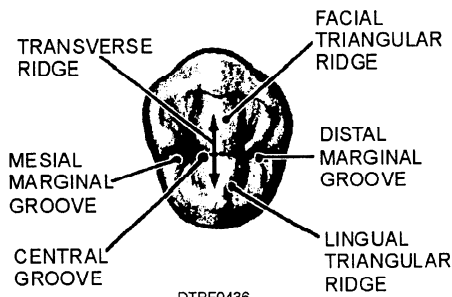
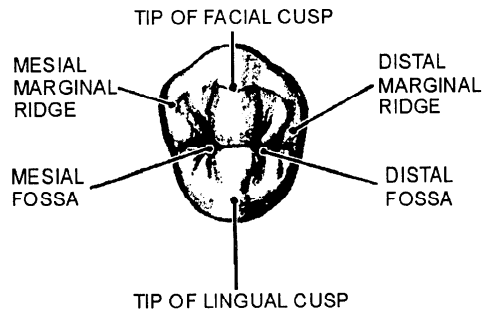


Figure 4-36.—Features of an occlusal surface of maxillary first bicuspid.

cusps.”) Sometimes bicuspid are called *premolars* because they are just in front of the molar teeth.

**Facial Surface**—The facial surface is somewhat similar to the facial surface of the cuspid. However, the tip of the facial cusp is located in the center of the “biting” edge, which is called the occlusal edge or occlusal margin. From the cusp tip to the cervical margin, there is a slight ridge, called the facial ridge, similar to the facial ridge found in cuspid teeth.

**Lingual Surface**—The lingual surface is narrower and shorter than the facial surface, and is smoothly convex in all directions. The cusp tip is in the middle of the occlusal edge.

**Root Surface**—The root is quite flat on the mesial and distal surfaces. In about 50 percent of maxillary first bicuspid, the root is divided in the apical third, and when it so divided, the tips of the facial and lingual roots are slender and finely tapered.

**Occlusal Surface**—The occlusal surface (fig. 4-36) has a facial cusp and a lingual cusp. There are mesial and distal marginal ridges. Two fossae are on the occlusal surface—the mesial and distal fossae.

## MAXILLARY SECOND BICUSPID

The maxillary second bicuspid (tooth #4 or #13), illustrated in figure 4-37, resembles the first bicuspid very closely, but is smaller in dimensions. The cusps are not as sharp as the maxillary first bicuspid and have only one root.

## MANDIBULAR FIRST BICUSPID

The mandibular first bicuspid (tooth #21 or #28), illustrated in figure 4-38, is the fourth tooth from the midline. It is the smallest of the four bicuspid. The term *bell-crowned* is used to describe its appearance. The mandibular first bicuspid has many characteristics of a cuspid.

**Occlusal Surface**—A large facial cusp, which is long and well defined, and a small nonfunctional lingual cusp are present on the mandibular first bicuspid.

**Root Surface**—The root of the mandibular first bicuspid is usually single, but on occasion can be bifurcated (two roots).

## MANDIBULAR SECOND BICUSPID

The mandibular second bicuspid (tooth #20 or #29), illustrated in figure 4-39, is the fifth tooth from the midline.

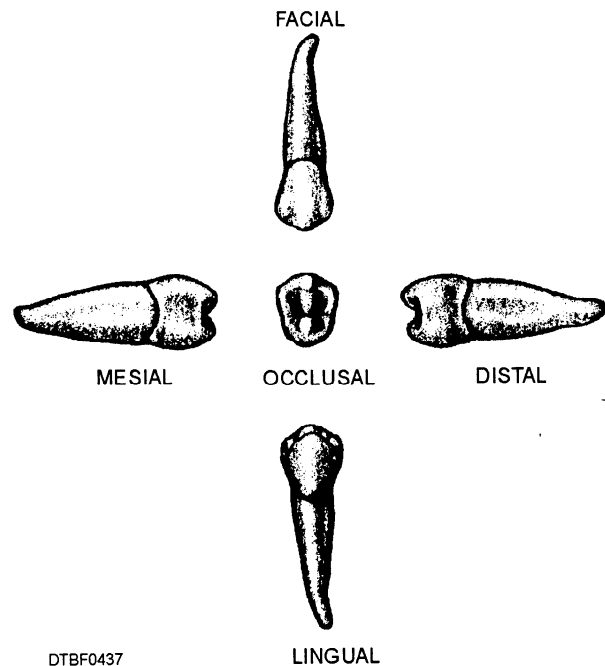
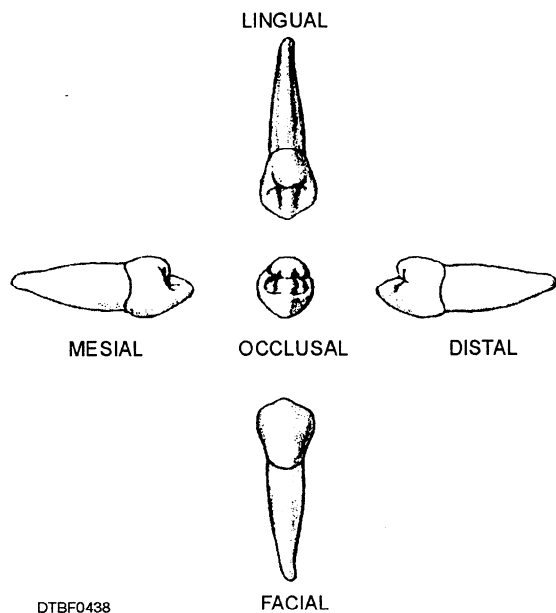
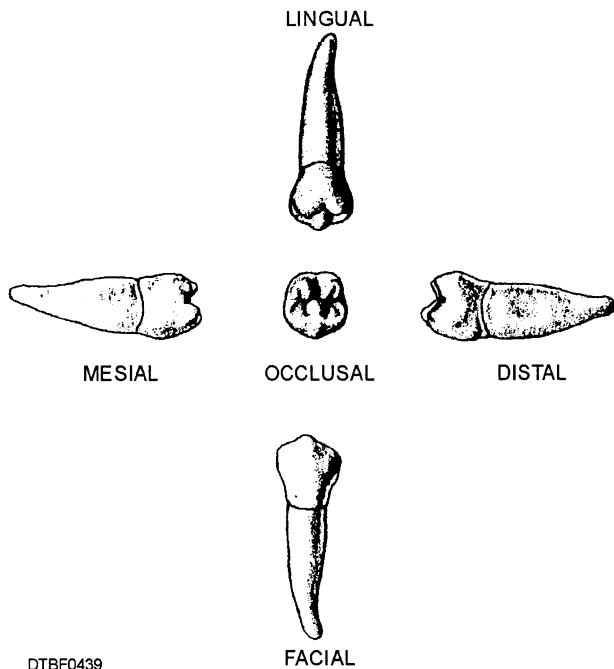


Figure 4-37.—Surfaces of maxillary second bicuspid.



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Figure 4-38.—Surfaces of mandibular first bicuspid.



DTBF0439  
Figure 4-39.—Surfaces of mandibular second bicuspid.

**Facial Surface**—The facial surface has the same facial surface as the first bicuspid.

**Lingual Surface**—The lingual surface is similar to that of the mandibular first bicuspid, with the exception that there may be two lingual cusps present.

**Occlusal Surface**—The occlusal surface usually has a total of three well-defined cusps. Viewed from above, the three cusps present a Y-form pattern.

**Root Surface**—The root of the tooth is single, and in a great many instances, the apical region is found to be quite curved.

## MAXILLARY FIRST MOLAR

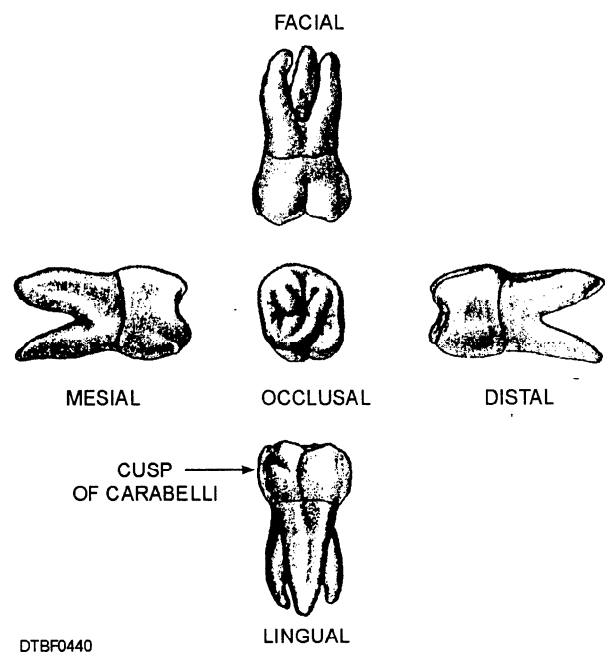
The maxillary first molar (tooth #3 or #14), illustrated in figures 4-40 and 4-41, is the sixth tooth from the midline. The first molars are also known as 6-year molars, because they erupt when a child is about 6 years old.

**Facial Surface**—The facial surface has a facial groove that continues over from the occlusal surface, and runs down to the middle third of the facial surface.

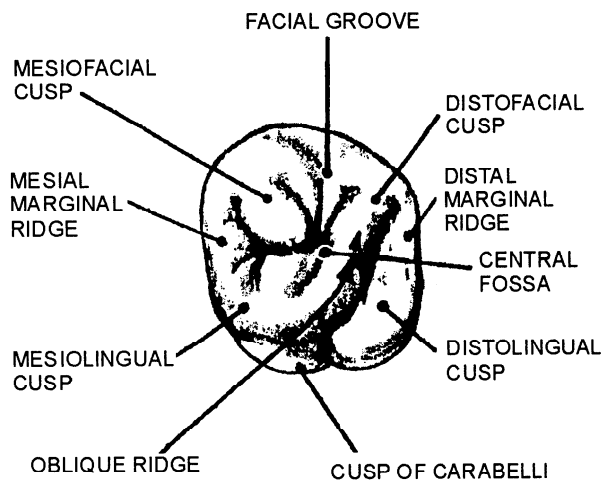
**Lingual Surface**—In a great many instances, there is a cusp on the lingual surface of the mesiolingual cusp. This is a fifth cusp called the cusp of Carabelli, which is in addition to the four cusps on the occlusal surface.

**Occlusal Surface**—In all molars the patterns of the occlusal surface (fig. 4-41) are quite different from those of the bicuspid. The cusps are large and prominent, and the broad grinding surfaces are broken up into rugged appearing ridges and well-defined grooves. An oblique ridge, which is not present on the bicuspid, appears here (it also appears on maxillary second and third molars).

**Roots**—The maxillary first molar has three roots, which are named according to their locations—mesiofacial, distofacial, and lingual (or palatal root). The lingual root is the largest.



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Figure 4-40.—Surfaces of maxillary first molar.



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Figure 4-41.—Features of occlusal surfaces of maxillary first molar.

## MAXILLARY SECOND MOLAR

The maxillary second molar (tooth #2 or #15), illustrated in figure 4-42, is the seventh tooth from the midline. The second molars are often called 12-year molars because they erupt when a child is about 12 years old.

Because it has the same function as the maxillary first molar, its physical characteristics are basically the same. The second molar is smaller, the occasional fifth cusp of Carabelli does not appear, and there is a marked reduction in the size of the distolingual cusp.

## MAXILLARY THIRD MOLAR

The maxillary third molar (tooth #1 or #16), illustrated in figure 4-43, is the eighth tooth from the midline. Third molars are often called wisdom teeth

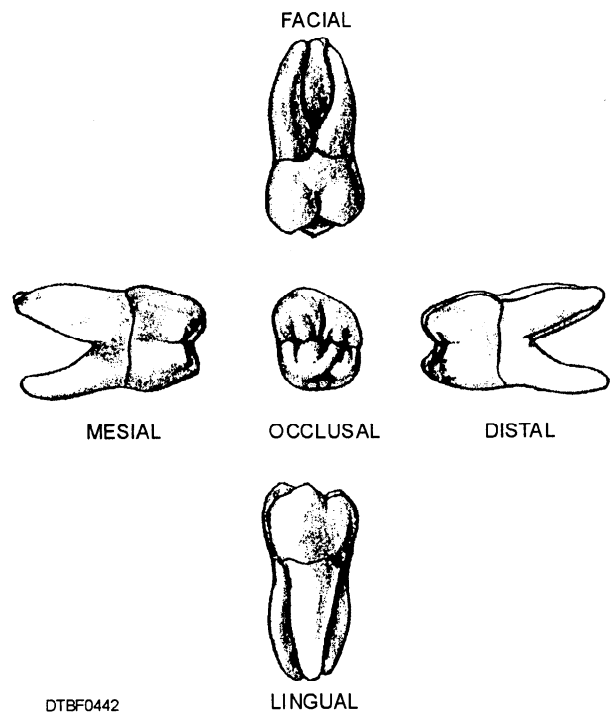


Figure 4-42.—Surfaces of maxillary second molar.

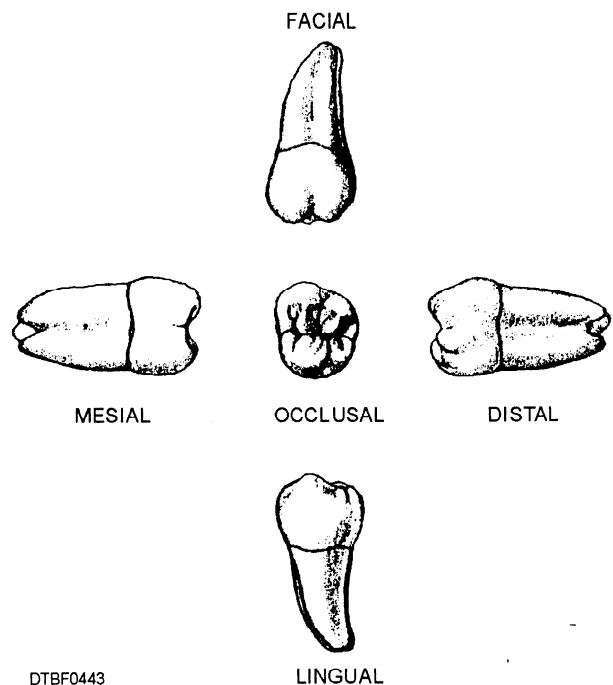


Figure 4-43.—Surfaces of maxillary third molar.

because they erupt when the young adult is passing into manhood or womanhood. The tooth is much smaller than the maxillary first or second molars, with an occlusal outline that is nearly circular.

## Occlusal Surface

Numerous fissures and grooves cover the occlusal surface. There is no distinct oblique ridge.

**Root Surface**—The root may have from one to as many as eight divisions. These divisions are usually fused and very often curved distally.

## MANDIBULAR FIRST MOLAR

The mandibular first molar (tooth #19 or #30), illustrated in figures 4-44 and 4-45, is the sixth tooth from the midline. It is the first permanent tooth to erupt.

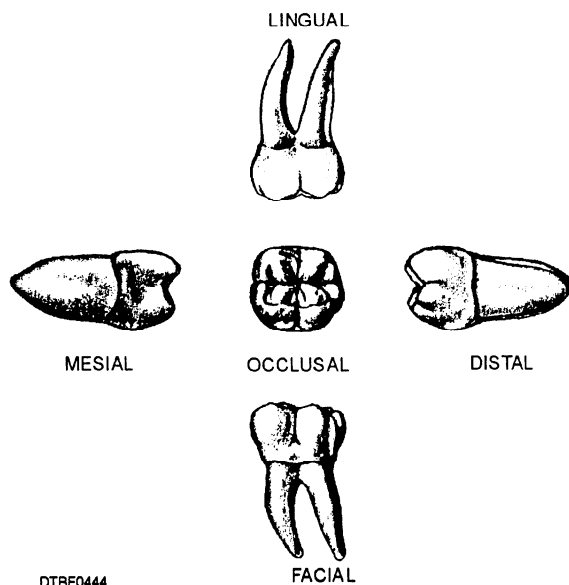
**Facial Surface**—The facial surface has two grooves: the facial groove, which is an extension of the facial groove from the occlusal surface and the distofacial groove, an extension of the distofacial groove from the occlusal surface.

**Occlusal Surfaces**—The occlusal surface has five cusps (fig. 4-45). The fifth cusp is called the distal cusp.

**Roots**—The tooth has two roots, a mesial and a distal.

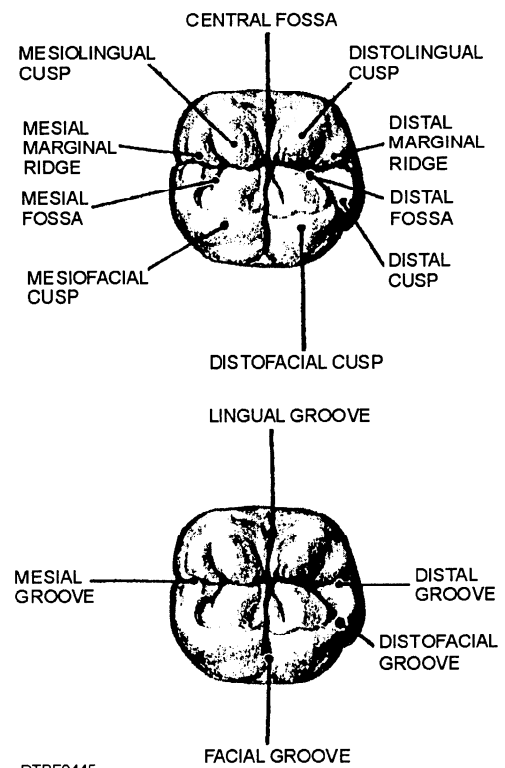
## MANDIBULAR SECOND MOLAR

The mandibular second molar (tooth #18 or #31), illustrated in figure 4-46, is the seventh tooth from the midline.



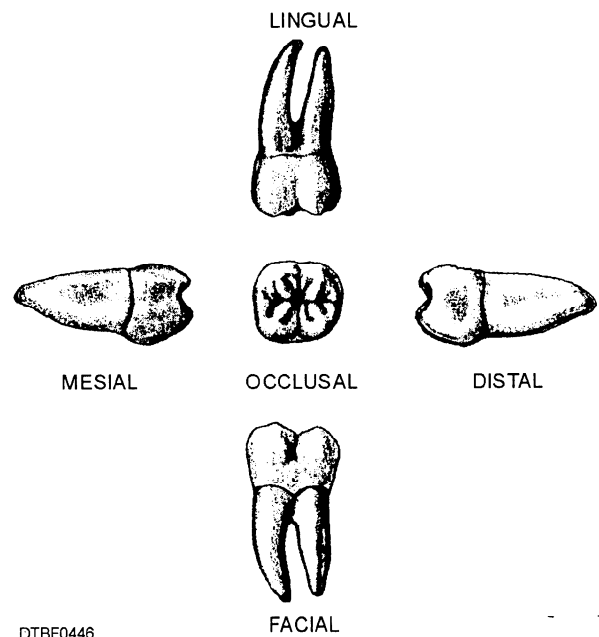
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Figure 4-44.—Surfaces of mandibular first molar.



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Figure 4-45.—Features of an occlusal surface of mandibular first molar.



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Figure 4-46.—Surfaces of mandibular second molar.

**Facial Surface**—The facial surface has only one groove, the facial groove, which arises on the occlusal surface, extends over the facial margin onto the facial surface.

**Occlusal Surfaces**—The greatest difference between the occlusal surfaces of the mandibular first

and second molars is that the occlusal surface of the second molar has no fifth cusp.

**Roots**—The mandibular second molar has two roots that are smaller than those of the first molar.

## MANDIBULAR THIRD MOLAR

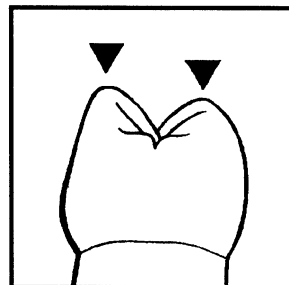
The mandibular third molar (tooth #17 or #32), illustrated in figure 4-47, is the eighth tooth from the midline. It appears in many forms, sizes, and shapes. Since its function is similar to that of the other two mandibular molars, its general appearance is the same. It has smaller surfaces, more supplemental grooves, and four or five cusps, which are not so sharply differentiated as those of the first two molars.

**Roots**—The roots, generally two in number, are shorter in length and tend to be fused together. In many instances they show a distinct distal curve.

## GLOSSARY OF UNIQUE DENTAL ANATOMY

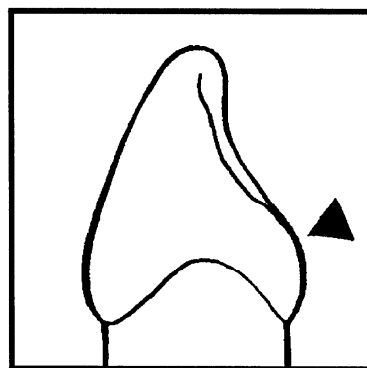
The following list will be helpful to you in understanding some of the anatomical terms used in this chapter.

**Cusp**—A pointed or rounded elevation of enamel found on cuspids and on the chewing surfaces of bicuspid and molars.



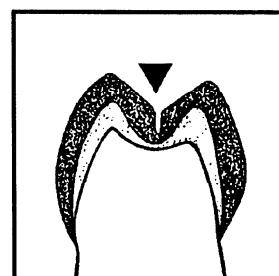
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**Cingulum**—Found on the lingual aspect of an anterior tooth. It is a convex mount of enamel localized to the cervical one-third of the crown.

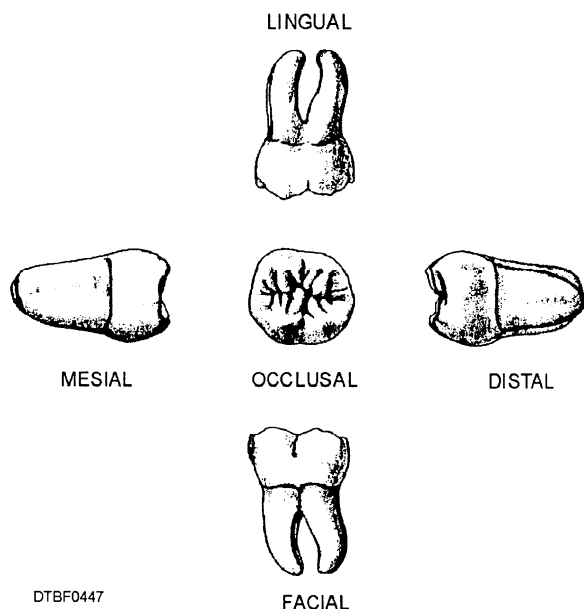


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**Fissure**—A linear fault that sometimes occurs in a developmental groove by incomplete or imperfect joining of the lobes. A pit is usually found at the end of a developmental groove or a place where two fissures intersect.



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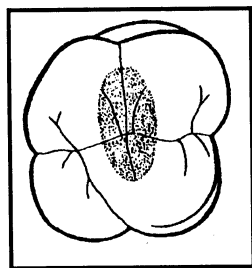


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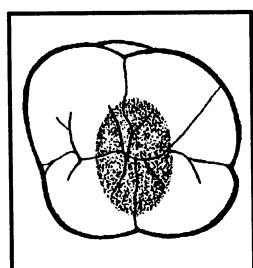
Figure 4-47.—Surfaces of mandibular third molar.

**Fossa**—A rounded or angular depression of varying size found on the surface of a tooth.

**Central fossa**—Centrally located depression found on the occlusal surface of molars and mandibular second bicuspid. The other bicuspid has mesial and distal triangular fossa, but do not have a central fossa.



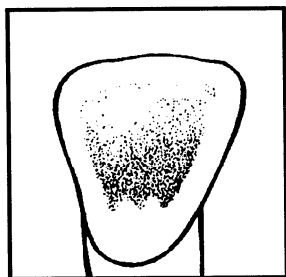
MAXILLARY MOLARS



MANDIBULAR MOLARS

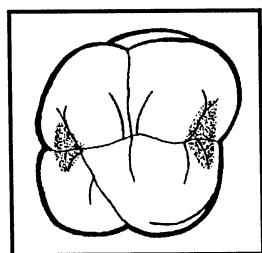
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**Lingual fossa**—Irregular, shallow depression found on the lingual surfaces of an incisor or cuspid.



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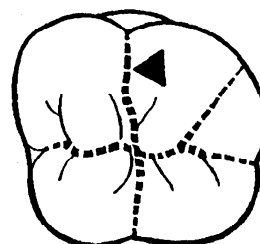
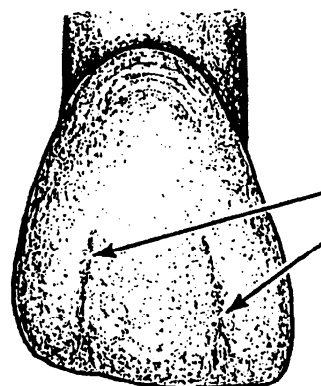
**Triangular fossa**—Located adjacent to the marginal ridges on the occlusal surfaces of posterior teeth. Two types of triangular fossae are mesial and distal.



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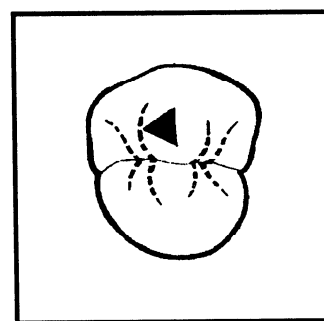
**Groove**—A small linear depression on the surface of a tooth.

**Developmental groove**—Fissure between the cusps on the crown of the tooth. Cusp tips are the initial site where enamel develops. As the enamel develops and spreads laterally, it touches enamel developing from other cusps. This junction forms a developmental groove. Such grooves appear on the labial, buccal, and lingual surfaces, and are least apparent on the labial aspect of anteriors.



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**Supplemental groove**—A minor, auxiliary groove that branches off from a much more prominent developmental groove. They do not represent the junction of primary tooth parts and gives the occlusal surface a wrinkled appearance.

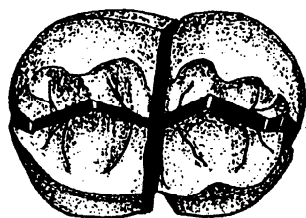


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**Lobe**—Is one of the primary divisions of a crown; all teeth develop from four or five lobes. Lobes are usually separated by readily identifiable developmental grooves.

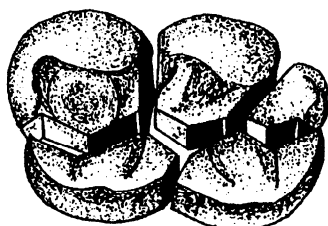


LOBES OF A  
CENTRAL INCISOR



← DEVELOPMENTAL  
GROOVE

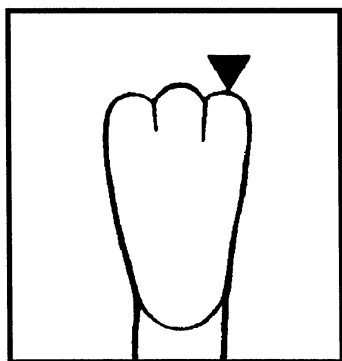
LOWER SECOND MOLAR



LOWER FIRST MOLAR

DTBF0456

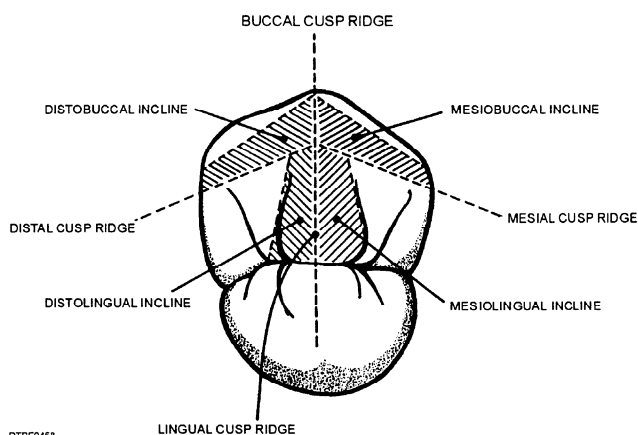
**Mamelons**—Are small, rounded projections of enamel from the incisal edges of newly erupted anterior teeth. The projections wear away soon after eruption.



DTBF0457

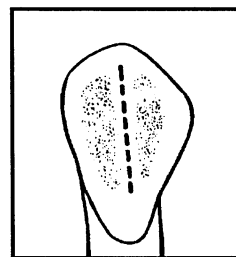
**Ridge**—Any linear elevation found on the surface of a tooth, named according to its location or form.

**Cusp ridge**—Each cusp has four cusp ridges radiating from its tip. They are named according to the direction they take away from the cusp tip (for example, mesial, distal, buccal, or lingual).



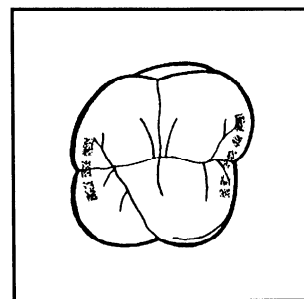
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**Lingual ridge**—The ridge of enamel that extends from the cingulum to the cusp tip on the lingual surface of most cuspids.



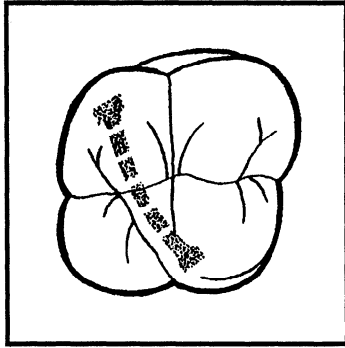
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**Marginal ridge**—A linear, rounded border of enamel that forms the mesial and distal margins of anterior teeth as viewed from the lingual, and the mesial and distal borders of occlusal surfaces on posterior teeth.



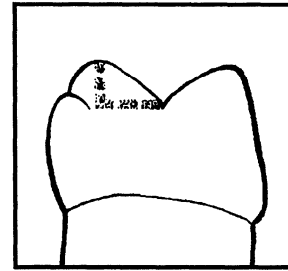
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**Oblique ridge**—The only tooth on which an oblique ridge is found is the maxillary molar. Consists of an elevated prominence on the occlusal surface and extends obliquely from the tips of the mesiolingual cusp to the distobuccal cusp.



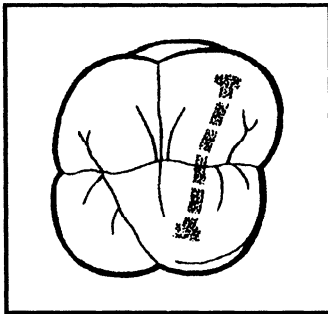
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**Triangular ridge**—Two inclines meet to form a triangular ridge and are located either on a facial or a lingual cusp ridge.



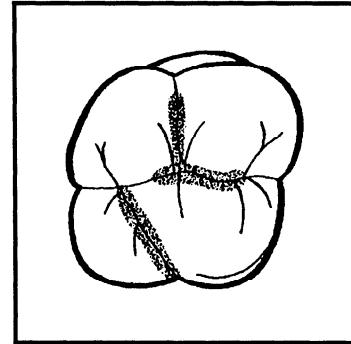
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**Transverse ridge**—The union of a buccal and lingual triangular ridge that crosses the surface of a posterior tooth transversely (roughly 90° to both the buccal and lingual tooth surfaces).



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**Sulcus**—An elongated valley or depression in the surface of a tooth formed by the inclines of adjacent cusp or ridges.



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